result in its decomposition, the formation of carbon and CO2, which is an exothermic reaction releasing 38.8 calories per molecular volume of CC>2 formed, and the deposition of soot on the tubes. Another source of soot lies in the hydrocarbons. The high firebox temperature has a tendency to break these up, forming soot, CO and hydrogen (Efo). The luminosity of the flame in the firebox is due to the heating of this soot to incandescence, and unless this floating carbon is burned in a properly designed combustion chamber a considerable portion of it will be carried to and deposited on the tubes.

Combustion, like all chemical reactions, follows the law of mass action and the laws of chemical equilibrium. The velocity of the reaction is affected by the temperature of the reacting masses, by the mixing of the combustibles and the comburent and by the dilution with inert gas. The velocity of the reaction increases very rapidly with the temperature. Tor example, a mixture of hydrogen and oxygen at 200° will require months to combine, while at 2200° the explosion wave indicates that combination occurs in one ten-millionth of a second. The ratio between the two velocities of the reaction is that of 1 to 10^{14}. Increases of pressure increase the velocity of the reaction. This factor, while important in internal combustion motors, does not amount to very much at the slight differences of pressure that exist in furnace fireboxes used in industrial heating. Dilution with inert gases slows down the reaction velocity by reason of the increase of the mass. The mixing has a considerable effect on the velocity of the reaction as may be readily verified by observing the flame of a Bunsen burner while altering the air supply. The slower the reaction velocity the longer the flame length and the distance the gases travel in burning. The temperature will be lower with

a long flame than ifc will be with a short flame.

In a boiler it is absolutely necessary that combustion should be completed before the water-cooled surfaces are reached, as complete combustion will result in the practical elimination of the soot trouble, with a resultant increase in the efficiency of the heating surface. Most boilers and settings, however, are so designed that the incandescent gases are shot up against a refrigerating surface before combustion can be completed. The so-called combustion arches and the baffling being so arranged that this refrigeration will be promoted, instead of combustion.